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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/782,558	02/13/2001	Carlo Rubbia	P-6150	9660

7590 04/17/2002

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EXAMINER

PALABRICA, RICARDO J

ART UNIT	PAPER NUMBER
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3641

DATE MAILED: 04/17/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/782,558

Applicant(s)

RUBBIA, CARLO

Examiner

Rick Palabrica

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-- Th MAILING DATE of this communication appears on th cover sheet with th correspondenc address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 24 January 2002.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 41, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-73 is/are pending in the application.
- 4a) Of the above claim(s) 1-24, 30, 31, 35, 51, 56 and 57 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 25-29, 32-34, 36-50, 52-55 and 58-73 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 8.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

1. Applicant's election without traverse of Group II (Apparatus of Space Engine with Gas heater), and associated claims 25-29, 32-50, 52-55 and 58-73 in Paper No. 10 is acknowledged. Note that the applicant incorrectly referred to said apparatus as Group I in said Paper, contrary to the designation of same apparatus as Group II in Office Action dated 1/24/2002.

2. Applicant's election with traverse of species in said Paper No. 10 is acknowledged. The traversal is on the ground(s) that the species requirements arbitrarily limit the scope of the invention. This is not found persuasive because the applicant's reply is not responsive to the requirement on pages 4 and 5 of said Office Action. Said reply is neither a clear admission that the species are not patently distinct nor a submission/identification of evidence showing the species to be obvious variants. Additionally, the applicant's plurality of species are clearly restrictable, per MPEP 806.04(e) and MPEP 806.04 (f), because: 1) they are clear alternative embodiments that are all suitable for the invention (e.g., ^{242m}Am and ^{239}Pu are equally suitable for the fissile material); and 2) they possess mutually exclusive characteristics, such as different neutron absorption cross sections, which are attributes that are important to the invention.

Accordingly, the species requirement is still deemed proper and is therefore made FINAL.

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3. Claims 30, 31, 35, 51, 56 and 57 are not considered because they are drawn to non-elected species.

Specification

4. The disclosure is objected to because of the following informalities:
- On page 16, line 14, and page 42, line 16, the symbol " \div " should be replaced either with the word "to" or symbol "-".
 - On page 18, line 9, the quantity, "k" should be defined.
 - On page 20, line 29, there is a missing term before the word "-decay."
 - On page 47, line 4, the acronym "ITER" should be defined.
- Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 25-29, 32-34, 36-50, 52-55 and 58-73 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the

specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Claims 25, 26, 49 and 52 disclose a “means for exposing the fissile material to a neutron flux to induce fission and the release of fission fragments into the chamber.” Page 6 of the specification, for example, discloses that the fissile material is exposed to a neutron flux to induce fission, whereby fission fragments are released into the chamber. Also, on page 14, the disclosure recites production of two fission fragments from the splitting of the initial nucleus, and on page 40, the disclosure states that fission fragments are produced by a highly fissile element (typically ^{242m}Am). The specification is not seen as setting forth a description of how and in what manner the fissile material is exposed to a neutron flux. In particular, the source or means to provide the neutron(s) necessary to create an initial fission in the fissile material is not disclosed.

Claims 43 and 68 disclose a “means for introducing the gas into the chamber through the pores of the porous wall material.” On page 8 of the specification, for example, the specification recites that the wall of the chamber is advantageously made of a porous material, and the gas can then be introduced through the pores of the porous material. Again, the specification is not seen as setting forth how and in what manner said gas is introduced into the chamber.

6. Claims 25-29, 32-34, 36-50, 52-55 and 58-73 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly

claim the subject matter which applicant regards as the invention. There is neither an adequate written description nor enabling disclosure on the claimed: 1) means for exposing the fissile material to a neutron flux; and 2) means for introducing the gas into the chamber. See details in section 4 above.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

7. Claims 25, 26, 28, 29, 32, 36-38, 42-45, 49, 50, 52, 54, 55, 58, 61-63, 68-70 are rejected under 35 U.S.C. 102(b) as being anticipated by Pettus (U.S. 5,289,512).

Pettus discloses a nuclear propulsion reactor that reads on said claims.

Pettus discloses a space engine comprising a gas heating device (Fig. 4, numeral 52) and a means for expelling the heated gas into space to generate thrust (see nozzle 18 in Fig. 1). The gas-heating device comprises at least one chamber that is tubular in shape and has its wall coated with ^{242m}Am , in the form of a carbide (see column 2, last full paragraph and column 3, lines 3-7). Fission reactions in the gas-heating device are caused by leakage neutrons from the first core (see Fig. 2, numeral 14, and column 1, lines 40-41). Pettus further discloses a neutron reflector surrounding

the enclosure of the gas heating device, said reflector having cavities for receiving removable neutron-absorbing control rods (see Fig. 2, numeral 25 and column 2, lines 7-14). The gas-heating device is in communication with the exhaust nozzle through a throat provided in the neutron reflector (see Fig. 1).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims 33, 39-41, 46-48, 50, 59, 64-66, 71-73 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pettus in combination with Walsh (U.S. 3,778,344) and Rom (U.S. 3,202,582). Pettus discloses the applicant's inventive concept except for the specifics on the propellant, and the material and cooling of the reflector.

Walsh discloses a nuclear reactor open-cycle rocket engine that uses liquid hydrogen as propellant (see Fig. 2 and corresponding parts of the specification).

Walsh's engine has a pressure chamber (11), including a reactor core (12) and rearward opening forming jet nozzle (9). The core is surrounded by a beryllium reflector and within the reflector are control drums (17) that are provided with cooling channels (19). The reactor core is rigidly held by an upper support plate (22) and a lower core support plate (27), the latter also providing separation of the exhaust region from the

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rest of the engine. Walsh uses liquid hydrogen both as propellant and coolant. As to the limitation in said claims regarding the use of carbon material for the reflector, this material, which is usually in the form of graphite, is a well-known expedient in the nuclear art as reflecting material because of its good neutron reflecting property due to its low atomic number, and so to use graphite as a substitute for beryllium would be prima facie obvious.

Rom discloses a gaseous nuclear rocket that uses hydrogen as a propellant/coolant and graphite as reflector (see column 3, lines 37-40). Rom teaches a propellant circuit that is separate from the cooling circuit.

As to the limitation in said claims regarding the use of ^7Li as coolant, this liquid metal is a well-known expedient in the nuclear art as coolant because of its good heat-absorbing capacity and its low molecular weight, and so to use ^7Li as a substitute coolant for hydrogen would be prima facie obvious.

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the nuclear rocket, as disclosed by Pettus, by the teachings of Walsh and Rom, in order to have a space engine wherein: 1) the heated propellant gas comprises hydrogen; 2) a neutron reflector comprising a carbon material (graphite); 3) a cooling medium of molten metal (i.e., ^7Li); and 4) the cooling medium is circulated in a circuit having a first portion on a face of the reflector adjacent to the hot gas collecting region and a second portion located in the fuel region. This modification is no more than the use of conventionally known designs/techniques within the nuclear rocket art.

9. Claims 27, 34, 53 and 60 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pettus in combination with Walsh and Rom as applied to claims 33, 39-41, 46-48, 50, 59, 64-66, and 71-73 above, and further in view of IDS document C2, Chikin et al. "Gas Heating by Fission Fragments in the Channel of a Pulsed Reactor," Atomnaya Energiya, December 1988, USSR, Vol. 65, No. 6) and Etherington (Nuclear Engineering Handbook). The combination as discussed above in section 8 discloses the applicant's inventive concept except for the specifics on the thickness of the fissile material and the reflector.

As to the limitation in said claims of having a fissile content of lower than 10 mg/cm³, Chikin discloses a gas-filled channel of a pulsed reactor wherein a layer of highly enriched nuclear fuel (90% ²³⁵U) of thickness 2.5 microns is applied to the inner surface of the graphite wall of said channel. Fission fragments from said fuel heat the gas similar to the claimed inventive concept. Based on a density of uranium = 19 gm/cm³ (e.g., see H. Etherington, Nuclear Engineering Handbook), the thickness of the nuclear fuel is equivalent to 4.7 mg/cm³.

As to the limitation regarding the reflector having a thickness of at least 50/d, where d = density of carbon material, this yields a thickness of at least 22 cm, based on a graphite density of 2.22 gm/cm³. Etherington teaches that graphite has a thermal diffusion length = 51.8 cm (see Table 24, page 1-20). It is well known in the nuclear art that a reflector should have a thickness of at least one thermal diffusion length in order

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to be effective, and to use a 51.8 cm thickness for the graphite reflector would have been prima facie obvious.

Modification of the combination to have included the teachings of Childin and Etherington would have been obvious to one having ordinary skill in the art at the time the invention was made, as such results are in no more than utilization of known techniques in the nuclear art.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. References C-E pertain to nuclear rockets and are relevant to the claimed inventive concept.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Rick Palabrica whose telephone number is 703-306-5756. The examiner can normally be reached on 8:00-4:30, Mon-Fri.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Carone can be reached on 703-306-4198. The fax phone numbers for the organization where this application or proceeding is assigned are 703-305-0285 for regular communications and 703-305-0285 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist, telephone number is 703-308-1113.

RJP
April 9, 2002

Charles T. Jordan
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